



**Engineering
Economics
Inc**

***Exemplary
Laboratory
Design
from the
Commissioning
Perspective***

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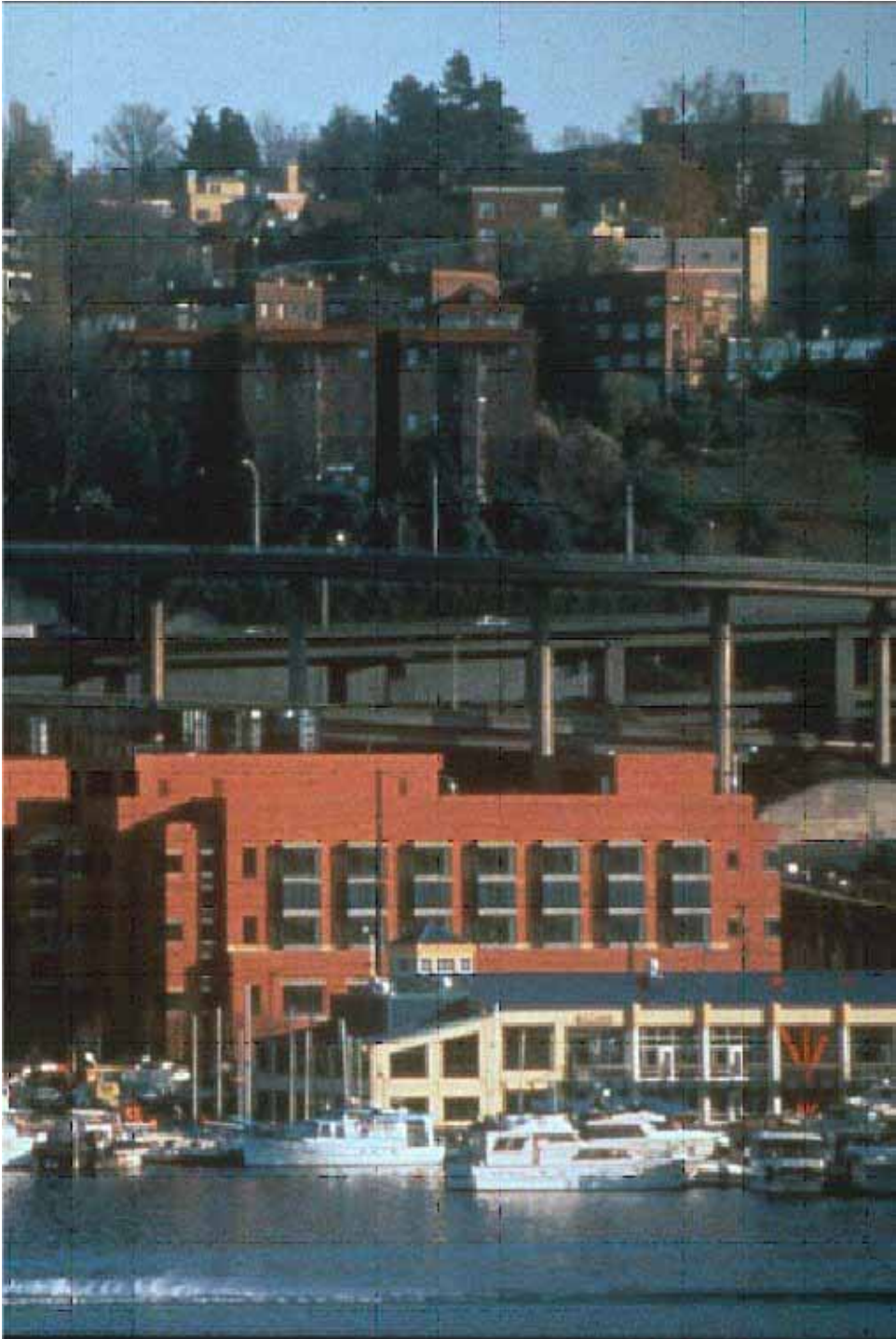
Introduction

- **Lessons learned from Cx (commissioning) experience**
- **Cx takes owner/operator perspective – achieve intended performance**
- **Focus on the design process**
- **Feedback to designers and owners**



Design Intent

- **Design Intent (DI) is the foundation for design of all systems**
- **Get extensive input from the owner**
- **Review other facilities with the owner**
- **Capture information in clear and concise format**



Design Intent

- Activity
- Occupancy
- Comfort
- IAQ
- Noise
- Illumination
- Performance
- Efficiency
- LEED
- Integration
- Controllability
- Expandability
- Flexibility
- Reliability
- Redundancy
- Maintainability
- Commissionability
- Budget
- Phasing
- Long-Term Use



Basis of Design

- Qualitative DI Descriptions become quantitative Basis of Design (BOD) criteria
- Develop the necessary level of detail to describe proper function
 - * Required vivarium conditions of temperature $70 \pm 2^{\circ}$ F, humidity $50 \pm 5\%$ RH, pressure $+0.03 \pm 0.02$ in. wc
- Review document(s) with owner to get buy-in and sign-off



Concept

- Develop concept to meet the DI and BOD criteria
 - * Cooling plant requirements of efficiency, controllability, expandability, and redundancy may dictate configuration
- Develop the concept with schematic diagrams or spatial P&ID's
- Depict controls on P&ID's, including outline sequences
 - * Primary/Secondary chiller plant P&ID versus plan depiction



Concept

- Walk the virtual system through sequences, operational modes, failure scenarios, etc.
 - * Parallel air handling unit controls
- Consider concept alternatives
 - * Keep it simple, reliable and maintainable
- Establish the preferred concept and refine it

Plans



- Perform load calculations to select equipment – right sizing per DI
- Develop plan layouts and sections for large system elements
 - * Utilize plans / sections to ensure everything fits
 - * Focus on complementary information
 - * Carefully locate key system elements and control devices on plan

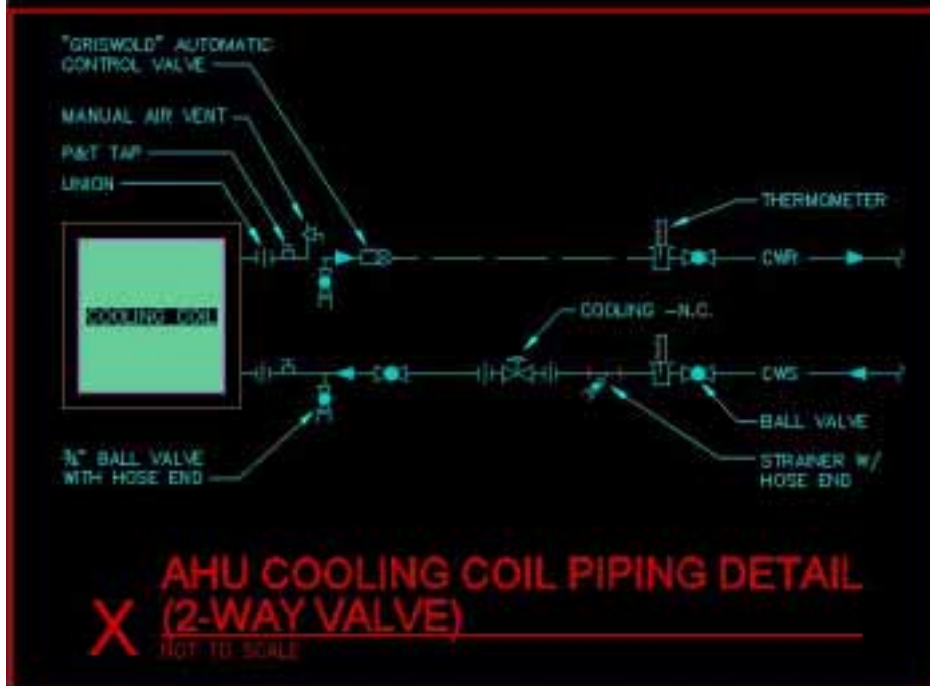
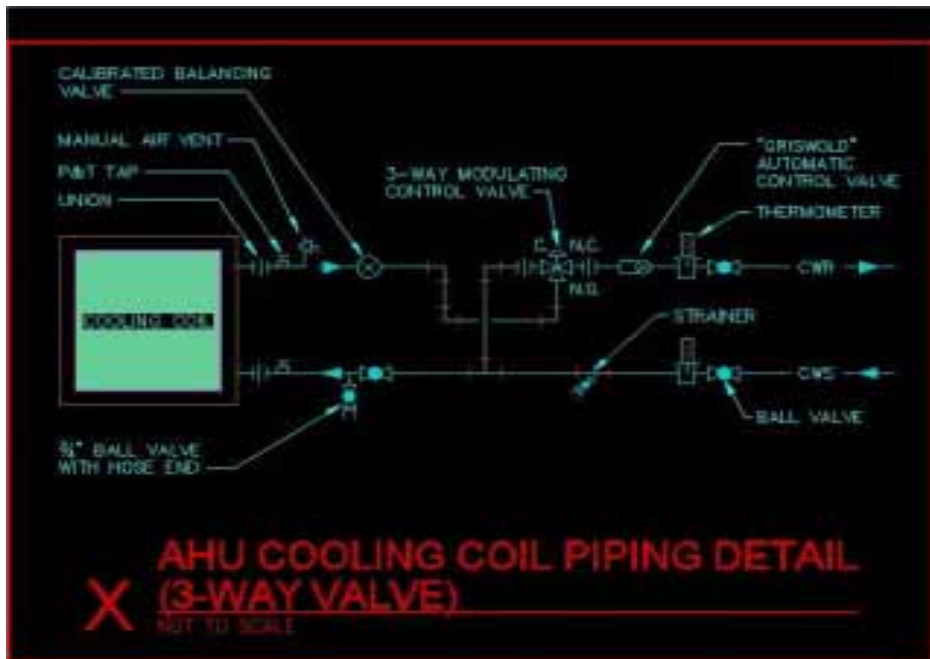
Plans

○ Select installation details to match P&ID's

- * 2-way valves versus 3-way valves
- * Depict P/T taps, thermometers pressure gauges, balancing valves, etc.

○ Schedule all equipment, even identical units, using owner's numbering standards

- * Maintain consistency between contractors and O&M





Specifications

- Contractor responsibilities to support Cx
- Incorporation of Cx activities into project schedule
- Systems Integration
- Requirements for control device ranges and calibration / adjustment
 - * Range and adjustment of current switches



Specifications

- Describe complete sequence of operation
- Document controls calibration factors and software revisions
- Contractor demonstration of appropriate system operation
- Review all design deliverables carefully before releasing
 - * Errors and inconsistencies cost the owner \$\$



Construction Administration

- Focus submittal review on compliance with plans and specifications
- Provide timely responses to contractor and Cx RFI's
- Be part of the solution, not part of the problem
 - * Designers stepping up to solve problems rather than stonewalling



Close-Out

- **Budget adequate time**
- **Focus installation review on compliance with plans and specifications**
- **Utilize Cx for operational status**
- **Incorporate Cx items into punchlist to aid in timely resolution**
- **Join the Cx team – We are here to help you!**